



INSIDER

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Costas Soukoulis Wins EU's Top Science Prize

Research team to share portion of 1 million euro Descartes Prize

Costas Soukoulis, an Ames Laboratory senior physicist and an Iowa State University Distinguished Professor of physics and astronomy, coordinates the research team that has won the Descartes Prize for Excellence in Scientific Collaborative Research, the European Union's highest honor in the field of science. He and his collaborators received the prestigious award for creating a novel class of artificial metamaterials called left-handed materials, or LHMs, which exhibit fascinating properties that cannot be found in naturally occurring materials.

LHMs exhibit negative refraction, bending light in the opposite direction to that seen in natural materials. They can be fabricated to have zero reflectance for all angles hit by incoming electromagnetic waves. In addition, they can focus light without the need for curved surfaces. These and other amazing properties promise a wide range of potential applications for LHMs.

Soukoulis, who has also been an associate with the research center FORTH, in Crete, Greece, since 1984, said he was lucky to work with a top-notch team of international researchers in creating the new subclass of materials. The team includes Professor Sir John

Pendry, Imperial College, UK; Professor Ekmel Ozbay, Bilkent University, Turkey; Professor Martin Wegener, University of Karlsruhe, Germany; Professor David Smith, Duke University, USA; and Professor E. N. Economou and Dr. Maria Kafesaki, both from FORTH and the University of Crete.

The research team was awarded the Descartes Prize for Research in Physics at a ceremony held at the Royal Society in London on Dec. 2. Of the 1,000,000 euro Descartes Prize

money, the team members will share 200,000 euro (\$235,634) given for their winning project, "Extending Electromagnetism through Novel Artificial Materials, or "EXEL."

"Our EXEL team was able to demonstrate the experimental reality of LHMs and their consistency with the laws of physics," said Soukoulis. "This realization opened up the possibility of unprecedented applications and devices."

The team has already shown how the ability to focus radio

waves could lead to smaller, better-performing magnetic resonance imaging machines for medical and biomedical diagnostics. Numerous applications in the cellular communications industry are also envisioned, including antennas and waveguides that are 100 times smaller and much lighter than those of today. Even slight improvements to these types of devices can make a significant financial impact.

Ames Laboratory Director Tom Barton *continued on page 2*



Costas Soukoulis accepts the Descartes Prize for Excellence in Scientific Collaborative Research at the Royal Society in London on Dec. 2. Members of the winning collaborative team are, left to right: Stephan Linden (University of Karlsruhe), Mike Wiltshire (Imperial College), Maria Kafesaki (FORTH), David Smith (Duke University), Martin Weneger (University of Karlsruhe), Ekmel Ozbay (Bilkent University), and Sir John Pendry (Imperial College).

praised the work of Soukoulis and the EXEL team, saying, "It probably would be difficult to overstate the potential importance of this historic scientific achievement to the future of optical technology. The Ames Lab and Iowa State University are indeed proud of the pivotal role played by Professor Soukoulis."

Accepting the Descartes Prize, Soukoulis paid tribute to the organizations that have supported his research on LHMs. "I would like to express my gratitude to Ames Laboratory and Iowa State University for accommodating my teaching duties to allow me to also pursue research on left-handed materials in Europe," he said.

"I would like to thank the U.S. Department of Energy for their support during the last 20 years. Our Ames Laboratory work on photonic crystals led to the field of negative index materials and metamaterials."

The Descartes Prize for Excellence in Scientific Research, now in its sixth year, recognizes out-

standing scientific and technological results achieved through international collaborative research in diverse disciplines. Winners are selected by a grand jury of experts in science, industry and the general public. ■

~ Saren Johnston

Pitching in After an F3

Malmquist and Bergman help in tornado cleanup effort

The tornado that touched down and left a path of destruction in Stratford, Iowa, on Nov. 12 was determined to be an F3 on the Fujita Tornado Damage Scale. What that boils down to is severe and damaging winds of 158 to 206 miles per hour. It's a wonder that the little town 20 miles northwest of Ames survived such an onslaught, but it did. And perhaps the bigger wonder, the wonder that allowed it to survive, was the human support that poured into Stratford from all directions.

Contributing to that massive support effort were facilities mechanics Richard Malmquist and Brian Bergman. Malmquist lives in Stanhope, straight east of Stratford, and Bergman lives in Stratford. Neither employee suffered damage to their homes, but both showed up immediately on that Saturday to help those who had.

"I was out storm-spotting," says Malmquist. "The tornado was just leaving town as I was coming in from Stanhope."

Bergman was in Fort Dodge shopping with his wife when he heard about the tornado in Stratford. "My daughter is a student at Iowa State, and she called us on her cell phone from the closet in her west Ames apartment," he says.

As they both rushed from separate directions to lend a hand in Stratford, neither Malmquist nor Bergman imagined the degree of damage they were about to see.

"There were power lines down everywhere, and I saw a canoe wrapped around a tree," says Bergman, whose status as a retired fireman of 15 years got him past the tight security surrounding Stratford in the wake of the tornado.

Malmquist recalls seeing an elderly man just sitting in his easy chair in the living room – perhaps too dazed to realize his good luck. "The roof of his house was completely gone," says Malmquist. "This person is on oxygen and can't go up and down stairs, so he couldn't take cover."

Bizarre sights were plentiful that night. Malmquist says he also saw a brick chimney laying in a bed and a staircase shoved into an attic. "I'm not sure what house it came from," he says.

On the Saturday night of the tornado, Malmquist helped out by going door to door to check for injured people. He also helped shut off broken gas mains and evacuate residents from the town.

Malmquist says he pretty much did whatever needed to be done. He helped distribute food supplied by the Salvation Army. "I took food to the deputies in town, and they were happy to get it," he recalls, noting that most of them had not eaten for 12-16 hours.

Bergman says he worked mostly with the city utility crews. "I rode in the boom truck with the electricians and helped rebuild power lines. My wife and daughter helped rake the yard at the elementary school so classes could resume as soon as possible to give the kids a sense of structure."

Malmquist emphasizes, "Volunteers poured into town on Sunday. There were probably a couple dozen Alliant Energy trucks there that morning – some from as far away as Centerville."

Bergman adds, "Contractors just showed up – there must have been 30 tractors and 30 skid loaders in town. We had the streets open by Sunday at noon. It was unbelievable the amount of cleanup that took place in that 24-hour period!"

Malmquist and Bergman worked all weekend in Stratford and extended their volunteer efforts by taking personal time from their jobs in the next week. Both say they were greatly impressed by the willingness of total strangers to come to the devastated community and pitch in wherever needed to help with the cleanup effort. ■

~ Saren Johnston



Richard Malmquist (left) and Brian Bergman study an aerial photo showing the path taken by the tornado that tore through Stratford on Nov. 12.



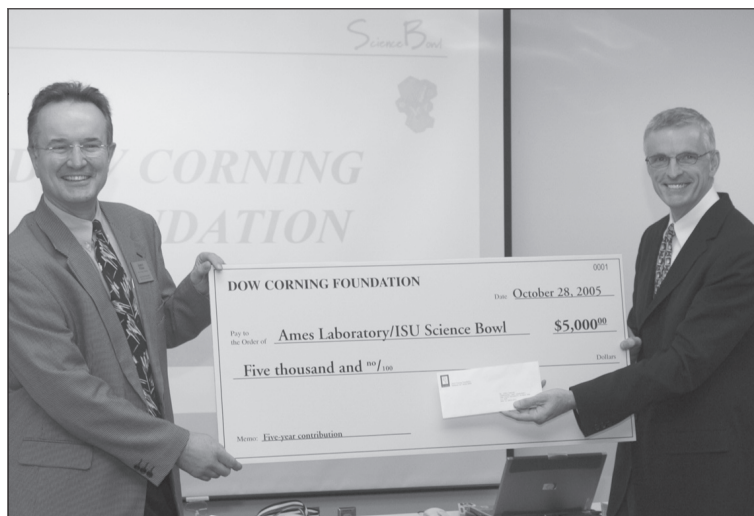
Super Support for Science Bowl

The meeting of the IPRT Industrial Advisory Board in October provided the perfect opportunity to recognize two of its corporate members, Rockwell Collins and the Dow Corning Foundation, for their generous support of the Ames Laboratory/ISU Science Bowl.

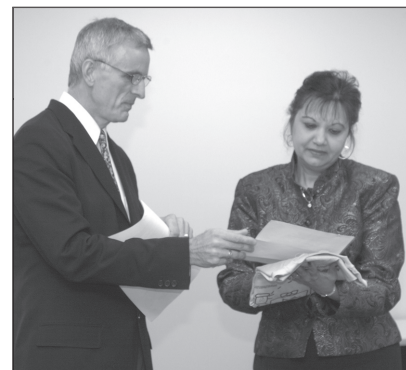
Steve Karsjen, Public Affairs manager and Science Bowl coordinator, thanked Rockwell Collins representative Nan Mattai for the company's continued and generous support since 1999, when the Science Bowl fundraising campaign began. "Not only did the contribution from Rockwell Collins help us get the ball rolling in 1999, but when I asked for more money in 2003, they doubled their contribution," said Karsjen. "Then when I asked for even more in 2004 to help us kick off our Middle School Science Bowl competition, they doubled their contribution again. This is a good company!"

Turning from an original sponsor to a new one, Karsjen recognized Dow Corning representative James White, saying, "It is with a tremendous amount of thanks that we welcome Dow Corning to our Science Bowl family with its commitment of \$5,000 over five years." Karsjen admitted that when he asked Dow Corning to be a sponsor he thought it would be a stretch for the Lab's request to match any of the company's funding categories. "I really believe that without the intercession of our 'champion,' James White, we would not be having this check-awarding ceremony today," Karsjen added.

Responding, White noted, "Steve's timing was impeccable because his request came when we were in the middle of reassessing our strategic plan and mission and were shifting it to focus on K-12 science and math education." White then presented Karsjen with the first installment of the \$5,000 commitment, a check for \$1,000, which will be used to help fund the 2006 Science Bowl competitions. ■



(above) James White, Dow Corning, presents Steve Karsjen with a check from the Dow Corning Foundation representing a \$1,000 donation to Science Bowl each of the next five years. (right) Nan Mattai, Rockwell Collins, reads an email announcing a \$1,000 donation for Science Bowl. Rockwell Collins has supported Science Bowl since 1999.



SCL Staff Attend "Gateway to Discovery"

Scalable Computing Lab personnel and students traveled to Seattle in November to participate in SC05, the annual International Conference for High Performance Computing, Networking, Storage and Analysis. Appropriately titled "Gateway to Discovery," the conference highlighted the expanding efforts of individuals within the high-performance computing community to provide HPC gateways to new and useful discoveries that will facilitate learning and increase knowledge.

The SCL's booth showcased the group's efforts to evaluate and improve the overall performance of real-world HPC applications on large cluster computing systems. The SCL booth also showed a



demo of a real-time InfiniBand network visualization tool, and participated in the SCInet OpenIB InfiniBand initiative to connect 30-40 booths on the show floor to a first-of-its-kind cross country InfiniBand network. Troy Benjegerdes, assistant scientist who participated in this effort, says, "I think this effort to push having an InfiniBand network on the show floor has accelerated

industry adoption of the InfiniBand networking standard by at least six months and encouraged many vendors to showcase new InfiniBand-based products at the show. In addition, the show-floor environment provided an opportunity for interoperability testing between different vendors' equipment that is simply not feasible any other way."

Brett Bode, associate scientist and coordinator of the SCL's exhibit at SC05, says, "The conference provided a unique opportunity to test and demonstrate many of the SCL research codes in a large and diverse environment. In addition, feedback from the diverse group of SC attendees gives us

invaluable insight into directions for further research."

Besides providing a venue for high-performance computing professionals from government, industry and academia to interact with one another, the conference also offers excellent networking opportunities for student participants. Graduate research assistant Sam Miller says, "I enjoyed meeting industry exhibitors to discuss potential job prospects related to my research interests. The tutorials program was also beneficial since it exposed us to new topics related to high-performance computing that we otherwise would not experience in classes at Iowa State." ■

Holiday Auction Raises Record Amount

More than \$3,200 to benefit Israel Family Hospice House

The people poured in and so did the money as employees crowded into the Spedding auditorium and large conference room to bid on both the silent and live auction items at the Ames Lab/IPRT annual Holiday Party and Auction, Dec. 7. The event brought in over \$3,200 for the Israel Family Hospice House that provides care and support for those who are terminally ill and their families.

In addition to raising funds for the Israel House, employees donated a huge number of mittens, gloves, hats and scarves of all styles and colors

to Mid-Iowa Community Action, nearly overwhelming the 6-foot tree they adorned in the Public Affairs office. Hundreds of food items – the presents beneath the tree – will also go to MICA.

A big thank-you to everyone who participated in helping make this year's Holiday Party and Auction an enormous success and, as always, a tremendous amount of fun! ■

~ Saren Johnston



Ready to party! With pizzazz and flare, Jean Boot models a scarf made by Lynnette Witt.



Not to be outdone by Jean Boot, Trevor Riedemann flaunts another Lynnette Witt original in a slightly flirtatious, come-hither manner. (Mega treats for this one, Trev!)



Director or Romulan commander – you decide!



"It's definitely you!" Bruce Harmon (right) admires Denny Sailsbury's new look wearing Skälpí. The scalp massager was donated by Todd Zdorkowski, who looks on approvingly.



Too cute for words! Steve Karsjen and Deb Covey show off their Santa hats.



Time for the big bucks – on with the live auction!



Santa's little helper elf, Deb Samuelson, keeps track of who owes what for what!



Deb Covey and Mark Murphy cut slices of pie – pumpkin, apple, cherry, pecan and lemon meringue – supplied by the Directors' office.



It's all about choices, but how do you choose from so many delicious-looking pies! (left to right: Sue Tourtellott, Karen Huiatt, Cathy Long, and Beverly Smith.)



A shopper's delight! Dongmei Wu (left), Xiao-Yun Yang, and Jean Boot check out the many and varied items up for bid on the silent auction.



"Let's see, $\pi r^2/8$... oh the heck with it ..."



In a losing battle with Mark Murphy, Deb Amenson bids on the Beauty Control products.

MPC Alloy Could Boost Next Generation Jet Fighter

Aluminum-yttrium-nickel alloy stronger and lighter

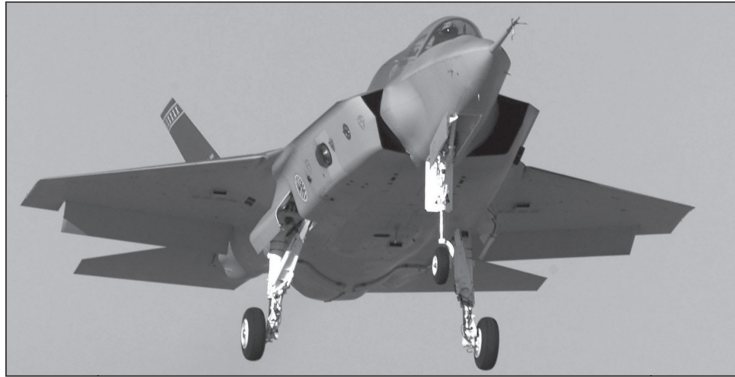
What started with a simple phone call four years ago has turned into a substantial project for Ames Laboratory's Materials Preparation Center. A high-strength aluminum alloy prepared at the MPC could be used in the F-35 Joint Strike Fighter, a cutting-edge aircraft that will see widespread use as the primary fighter for the U.S. Navy, Air Force, and Marines as well as U.S. allies abroad.

"I got a routine phone call from a researcher at University of Connecticut asking about our work with aluminum alloys," says MPC Director Larry Jones. "One thing led to another and in November of 2001, we hosted a group from (aircraft engine manufacturer) Pratt & Whitney and a number of other public and private institutions to talk about developing structural amorphous materials for the JSF project."

The MPC will produce roughly 400 pounds of an aluminum-yttrium-nickel alloy over the next few months that will serve as a benchmark for testing and to help refine commercial production techniques. The material is being developed in conjunction with Pratt & Whitney and its research partners to replace heavier or costlier components in the "cool" sections of jet engines. The material also could be used in other parts of an aircraft such as wing spars.

"When it comes to aircraft design, you want the strongest and lightest materials to get the most efficiency," Jones says. "We (the MPC) have the expertise, processing capabilities and high purity raw materials to develop an alloy that performs up to the requirements for this project."

If the new material performs up to expectations, it could have a dramatic impact on the performance and efficiency of both commercial and military aircraft. Jones says Pratt & Whitney engineers



The Lockheed-Martin X-35A is a test version of the Joint Strike Fighter which could someday be built with an aluminum alloy developed at the MPC.

estimated that replacing various components in one particular jet engine with the Al-Y-Ni alloy could potentially lighten the engine by 350 pounds. That's an astronomical weight reduction in aircraft design, where engineers are typically happy to reduce the weight of components by a few pounds here or there.

"It means being able to carry significantly more fuel or payload," Jones says. "It could also mean lower production costs," he adds, pointing out that a bulkhead currently milled from a solid block of titanium for the Joint Strike Fighter takes months to fabricate.

The alloy is produced using a process called high-pressure gas atomization. Pioneered at Ames Laboratory in the 1990's by metallurgist Iver Anderson, the HPGA process uses a special nozzle to blast a stream of molten material with a pressurized gas such as helium or nitrogen. The result is powder-fine metal particles that are highly uniform in chemical composition and, because they cool so quickly, exhibit the amorphous structure of the liquid metal rather than the crystal structure normally found in bulk metals.

The powdered metal is currently vacuum hot-pressed and hot extruded, a process that bonds the particles together while retaining some of the amorphous structure. This partially amorphous, partially

crystallized structure gives HPGA-produced materials improved properties, such as strength and ductility. Preliminary tests of the MPC's Al-Y-Ni alloy show it far exceeds anything commercially available. The top commercial aircraft-grade aluminum has a tensile strength of 75,000 pounds per square inch while this alloy has exceeded 100,000 psi in repeated preliminary tests.

Tests of the Al-Y-Ni alloy produced by a commercial manufacturer, however, have yielded less desirable results in the 90,000 - 92,000 psi range. While the basic "recipe" is the same, Jones says there are a number of inherent problems that ultimately affect the strength.

"Aluminum powders are used as rocket fuel so they're highly explosive," Jones says. "By using nitrogen gas in our process, it creates a nitride passivation layer so the powders are less likely to be explosive. This nitride layer breaks down during sintering, resulting in very strong bonds between the particles."

By contrast, Jones explains that the commercial process injects oxygen into the atomization gas stream to create a controlled oxidation of the powders. While the oxidation layer reduces the explosiveness, it remains during sintering, resulting in weaker bonds between particles.

"Purity of the materials go-

ing into the alloy also affects the overall strength," Jones says. "Any exogenous material will result in a weaker end product, including any oxidation that takes place."

To address this problem, the material being produced by the MPC will be kept in an inert environment until after the vacuum hot pressing process is completed. The MPC has modified its HPGA system to capture the powder in a container under an inert atmosphere. The powder will be sieved to less than 32 microns in size in an inert atmosphere glove box before being shipped in a sealed container to DWA Aluminum Composites where the vacuum hot pressing process will be completed. After vacuum hot pressing the pressed and sintered powder billet will be extruded. Only then will it be exposed to the normal atmosphere. The results will be studied to help modify and improve processing at the commercial level.

Funding for the production of the material – approximately \$475,000 – comes from Pratt & Whitney and the Defense Advanced Research Projects Agency, the central research and development organization for the Department of Defense. DARPA manages and directs selected basic and applied research and development projects for DOD, and pursues research and technology where risk and payoff are both very high and where success may provide dramatic advances for traditional military roles and missions.

"Our atomization capability all came about as a result of basic materials research funded by the Department of Energy's Office of Basic Energy Science," Jones says. "It's exciting to see the atomization process we developed advance to this point where it can make a real contribution to a project like the JSF and potentially the entire aviation and aerospace industry." ■

~ Kerry Gibson

Hackers Beware!

Strasburg and Wolterman hold off the "bad guys"

Countering numerous attacks by insidious hackers, Chris Strasburg and Robert Wolterman managed to keep their networks secure during the 18-hour Cyber Defense Competition held at the Iowa State University Research Park, Nov. 18.

"It was a lot of fun," says Strasburg of the all-night computer marathon that required constant vigilance and sharp problem-solving skills to ward off the attacks from Infraguard. Coordinated by the FBI, Infraguard is composed of corporate and government representatives who share an interest in security issues.

Strasburg, a systems support specialist in the Lab's Information Systems office, says he observed the event last year and was very impressed. A year later, while taking a computer security class, he ended up sitting next to Nate Evans, the student who was organizing this year's competition. The temptation was too great, and Strasburg began to form an Ames Lab team, first recruiting Wolterman, a student employee who provides computer assistance to the Directors' office staff. To complete the required four-person team, they added ISU students Josh Adams and Jay

Becker, both of whom work at the Research Park. They called their team The Promised LAN (local area network).

Wolterman says no one took a catnap during the all-nighter. "We were busy the whole time. We had to keep the network secure and also complete hourly reports on detecting attempted intrusions."

Strasburg adds, "We scored most of our points through our reports that explained how we fixed the various problems that arose. The hackers were never able to break into our network."

The Ames Lab team placed second out of the 12 teams that participated in the Cyber Defense Competition. Team members each received a certificate, a Cyber Defense T-shirt and a \$20 coupon from the University Book Store.

"Promised LAN was the most creative team seen from the perspective of new technologies," says Evans. "They implemented a directory lockdown policy along with numerous other complications. The hackers picked on this team the most due to the fact that they were always up and running. Always."

Although the time commitment



Robert Wolterman (left) and Chris Strasburg defend their network (and their M&Ms) from the evil Infraguard hackers.

for taking part in the Cyber Defense Competition was significant – about 20 hours per week for four weeks prior to the competition – Strasburg and Wolterman both say they'll be eager to compete in the next local competition if one is held in the spring. If there is no local competition in the spring, their team will be participating in the regional competition as the runner-up from the November event.

Strasburg and Wolterman are

already discussing ways they might improve their network defense strategies as they look forward to the next competition. After all, as Strasburg so aptly summed up their recent experience, "It's a computer geek's dream – stay up all night, drink pop and eat pizza. What more is there to life!" ■

~ Saren Johnston

Baldwin on "Talk of Iowa"

Midwest Forensics Resource Center Director David Baldwin, center, fields a question from WOI radio talk show host Catherine Perkins. Baldwin, state Crime Lab director Jerry Brown (right) and University of Northern Iowa professor Tyler O'Brien, who participated by phone, discussed the affect of the "CSI" TV shows on real-life crime investigations.



New Employees

Oleksandr Dolotko, postdoctoral fellow (Vitalij Pecharsky)
Andreas Kreyssig, assistant scientists III (Alan Goldman)
Yogesh Singh, postdoctoral fellow (David Johnston)
Lyudmila Slipchenko, postdoctoral fellow (Mark Gordon)
Milton Torikachvili, visiting scientist (Paul Canfield)
Daniel Uhl, Plant Safety Patrol Officer (G. P. Jones)

Promotions

Debra Covey from program manager I to program manager II

EMS Group Sets Energy-savings Actions

The Environmental Management System Steering Group looks at how the Laboratory might reduce its impact on the environment by identifying ways to conserve energy, reduce waste and lessen the drain on natural resources. The group meets annually to share its recommendations of best practices with the Executive Council. Based on recent EMS recommendations, the following timeline and actions have been approved by the Executive Council.

March 31, 2006 – Information Systems will develop recommendations for seeing that computer hardware utilizes all available system-specific energy-saving options, such as enabling hibernation and shutdown features for monitors and CPUs.

April 30, 2006 – Information Systems will create and set into motion an awareness communication program that encourages employees to enable power-saving features on their computers.

October, 2006 – Lab management will request the vending company to use Energy Star compliant vending machines in DOE-owned buildings.

Employees with energy-savings ideas should contact Dan Kayser, EMS chair, kayser@ameslab.gov.

Research Mentors Sought

The Program for Women in Science and Engineering is seeking mentors among faculty, staff and affiliate researchers for the 2006 undergraduate summer internship program. Application deadline is Feb. 3, 2006. Contact Lora Leigh Chrystal, 4-5278, lchrysta@iastate.edu or visit: <http://www.pwse.iastate.edu/faculty/interhips.html>.

Volunteer Reminder

Science Bowl is Sat., Jan. 28. Direct questions regarding training times or checking in at the Memorial Union on the morning of the competition to Saren Johnston, 4-3474, sarenj@ameslab.gov.

Local-use Vehicle

If you have need of a local-use vehicle, contact Peggy Lee at 4-3756 to reserve and make key arrangements for the white Ford F150 pickup.

HAPPY NEW YEAR!

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